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DEVELOPMENT OF A PORTABLE DATA RECORDER

TASK I REPORT

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INTRODUCTION

The US Geological Survey (USGS) has found it necessary to collect from lease operators more and more data concerning the installation, operation and maintenance of safety and pollution control equipment. In addition, each installation is inspected by USGS personnel at least twice per year. Equipment operating performance is again recorded at this time.

For the resulting mass of data to be of maximum use, it is entered into a computer controlled data bank. There it may easily be stored, analyzed, categorized and made to provide both raw and statistical data that will aid in the recognition of such things as potential safety problems related to safety component malfunction.

While such a program can lead to beneficial results, it is also evident that the implementation of this program can lead to a greater paper-work load for both government and industry. This results when the traditional method of manually filling out forms with the appropriate data and written comments, recording these data into the appropriate format for keypunching, and the subsequent keypunching of this data for input to a computer data bank is followed. Also, written comments might tend to be omitted or incomplete due to a tendency by inspection personnel to have an aversion to writing or paper-work in general.

Presently, Harry Diamond Laboratories is in the process of developing a Portable Data Recorder (PDR) for use by the US Geological Survey. This recorder is intended to be used for the recording of data by U.S. Government personnel inspecting offshore drilling rigs. The PDR should significantly decrease the paper-work load associated with inspection activities.

The purpose of this report is to describe the requirements of the USGS inspectors with respect to their use of the Portable Data Recorder. This will be accomplished by reviewing the data handling system now in use, evaluating the improvements allowed by the PDR, and finally specifying the characteristics required of the PDR so that it will be of maximum use in the inspection process.

CURRENT OPERATIONAL SCENARIO

A rather complex sequence of operations is currently required to get operational data collected by the inspector in the field into the USGS computer data base. This sequence, consisting of seven interrelated steps, is shown schematically in Figure 1. The design and implementation of the PDR should be such that it simplifies or eliminates some of all of these steps. Particular attention should be paid to those steps which are labeled HUMAN ERROR SOURCES. The following is a detailed explanation of each of the seven steps shown in Figure 1:

Step 1. Inspection Forms Are Prepared And Sent To Field Inspectors.

Based upon data resident in the USGS computer data bank, inspection forms are printed for use by the field inspectors during the inspection of a particular offshore structure. These forms contain the most recent data collected by the inspectors on that facility. Also, there is space provided for the inspector to enter current data values as well as any appropriate comments he might have.

Step 2. Inspectors Enter Data And Comments On Forms During Inspection Of Platform.

A team of inspectors are scheduled to inspect particular offshore facilities over a one to three day period, depending upon the size of the facility and the type of inspection scheduled. Once the inspectors have arrived on the platform, they check in with the local operator's field supervisor. The ensuing inspection then takes place in three phases.

In the first phase, the inspectors are provided with records of the inspection data collected by the company since the last USGS visit. These data are evaluated and the appropriate values are entered onto the USGS inspection forms. An Incidence of Non-Compliance (INC) is issued if the

proper tests were not conducted by the operator or if the test data indicated an unsafe condition for which the required corrective action had not been taken. Issuance of an INC requires the use of forms other than the inspection forms normally used by the USGS inspectors.

While one inspector is reviewing the company records, the other member of the team makes a visual inspection of the platform. As part of the second phase, he fills in that part of the inspection form dealing with such safety items as potential fire hazards (improperly stored flammable materials, improperly deployed or maintained fire-fighting equipment), personnel safety items (holes in the deck, cluttered walkways, missing or loose stair railings) and maintenance of signs identifying the structure, its operator and location. If the operator is found to be delinquent in any of these areas, he is issued an appropriate INC.

The third phase of the inspection calls for the USGS teams to witness the testing of certain equipment by operator personnel. The results of these tests are recorded on the inspection forms and evaluated to see that the equipment performance complies with the USGS regulations. Again, unacceptable performance results in the issuance of an INC.

In addition to recording the results of the test and inspection of individual items, before the inspection forms are turned in to USGS, the inspector must provide a summary of certain information. This includes such things as the number of items of a certain type that were inspected, the number that passed inspection, and the number that failed.

Step 3. Inspection Forms Are Returned To Local Computer Facility.

Once the inspection forms are completed by the field inspector, they are returned to the district office for subsequent entry into the computer data bank. This involves a physical transfer of the forms by means of a special messenger or the U.S. Postal Service.

Step 4. Inspection Data Is Coded And Transcribed By Hand Onto Keypunch Forms.

All inspection forms received by the district offices are reviewed and the data entered by the inspectors is recorded and transcribed onto keypunch-formatted forms. The code used is compatible with the data input format requirements of the USGS data base system. This entire step is of necessity done by hand.

Step 5. Contractor Keypunches Data.

Once the keypunch forms are completed, they are sent to a contractor who generates punched cards based on those forms. These cards and the forms are returned to the USGS district office.

Step 6. Cards Are Checked On Local Computer For Format Errors.

Upon receipt of the punched cards from the contractor, the cards are read by a computer in the district office. The computer is programmed to check for format errors in the punched cards. Any format errors that are detected are corrected by repunching the appropriate cards.

Step 7. Data Is Input To Computer Facility.

Once all detected format errors have been corrected, the data contained on the punched cards is entered into the USGS data base. There it will eventually be used to provide a basis for the printing of the inspection forms required for the next inspection of that particular offshore facility.

OPERATIONAL SCENARIO UTILIZING PDR

The following is a step-by-step description of the changes in the operational sequence that would be allowed by the use of the PDR. The resulting data-handling system is depicted schematically in Figure 2.

Step 1. Cassette Tapes (And Inspection Forms If Desired) Are Prepared And Sent To Field Inspectors.

The same data that is currently used to generate the inspection forms would be used to generate the tape cassettes used in the PDR. This tape preparation could be done either in the district office as is now the case for the printed forms, or in the field offices via telephone link. This latter option is available since the PDR itself could be interfaced to the telephone link and used to record the required data onto the tape. If desired, the currently used printed form could also be supplied to the field inspectors during a transition period from the current data-handling system to that based on the use of the PDR.

Step 2. Inspectors (Prompted By LED Display) Enter Data And Record Verbal Comments During Inspection Of Platform.

The USGS inspector would use the device's keyboard to enter digital data in the same format required as if he were to manually fill out the coded forms now used. When the inspectors are working independently, each would require access to a PDR. As the data is entered via the keyboard, it would be output to an LED display for the inspector to check. The digital data, as well as appropriate verbal comments (spoken into a microphone), would be recorded onto a magnetic tape cassette. Data playback (via the LED display or a speaker) and editing capabilities could be utilized.

The PDR would reduce human error in this step of the data collection process by providing visual and verbal prompts to the operator and by

checking the digital data for format errors. Also, this device would provide these capabilities while decreasing the burden on the USGS inspectors, since it could be programmed to automatically provide the information summaries now required of the inspectors.

Step 3. Cassette Tapes Are Returned To Local Computer Facility Or Played Back Over Telephone Link.

While the cassette tapes could be physically transported back to the district office (as is now the case for the printed forms), it would no longer be necessary. The PDR could be used to play the data back over a telephone link instead. This would eliminate any possibility of these records being lost or destroyed in transit.

Step 4. Contractor Keypunches Verbal Comment Data.

Rather than keypunching all of the data obtained (as is now the case), the contractor need only keypunch verbal-comment data. This data could be easily provided in the form of a recording. Note that while keypunch errors might still occur, they would be of a much less severe nature. Instead of changing a numeric value or misrepresenting an alpha numeric code, mispunched characters would now typically result in mispelled words. Thus, a potentially severe error source is largely eliminated.

Step 5. Data Is Input To Computer Facility

This last step in the sequence is accomplished by entering keypunched verbal-comment data from cards as is done in the current operation. In addition, the digital data originally recorded by the inspector via the PDR keyboard is entered by a playback of his original tape or from a recording of his tape made via telephone link.

EVALUATION OF OPERATIONAL CHANGES

A comparison of the currently used operational sequence and that anticipated for use with the PDR would be of value. As outlined above, these two scenarios have some significant differences. The most important of these differences are discussed below.

The first step in both cases is the output of information from the data base in a form that is of use to the field inspector. Differences include the ability to provide this information via telephone links instead of physical transferral from the district to the field offices. A second possible advantage is the ability of the district or field supervisor to easily include last minute verbal instructions to the field inspector directly on the cassette containing inspection information.

In the second step, inspectors are recording information for eventual inclusion in the data base. For either system, they can review prerecorded data from the previous inspection to help evaluate current conditions, record currently observed conditions and review and make required changes in data just recorded. Visual prompting by the PDR's LED display and data format-error checking may tend to decrease the amount of human error in this step. Another difference is that in one case they use pencil and paper while in the other the PDR containing a keyboard, LED display, microphone, and speaker system, is used. A third difference is that data summaries now required of the inspector could be automatically provided by the PDR.

The main difference found in step 3 is the elimination of the requirements to physically transport the collected data from the field office to the district office.

Step 4 of the current system is completely eliminated. It should be noted that this is one of the three steps in which human error could be introduced.

The next step is having data keypunched. With use of the PDR, this step

is greatly simplified, since much less data needs to go through this process. In addition, the effects of human error are greatly reduced. Finally, key-punching would be done from a recorded tape rather than from a written form.

The final step involves updating the computer data base. As previously stated, use of the PDR requires data input in both punched card and digital tape format.

REQUIREMENTS OF RECORDER

In order that the inspector be able to use the Portable Data Recorder as outlined in the preceding sections, it must have a number of specific operational capabilities. In addition, it must be highly portable, convenient to use, and able to withstand the harsh environment in which it must perform its intended function.

If the PDR is to have the specific operational capabilities required of it, then it must provide the following operations:

(1) Manual keyboard entry of digital data.
(2) Display of digital data as it is entered.
(3) Format error checking of digital data.
(4) Verbal input of comments.
(5) Playback and redisplay of digital data.
(6) Audio playback of verbal comments.
(7) Prompting of inspector to aid in his progress through the inspection data acquisition process.
(8) Editing of digital and verbal data.
(9) Automatic control of tape cassette drive.
(10) Data recording or playback via a telephone coupler.
(11) Format check of data transmitted over telephone coupler.
(12) Direct generation of computer data records (with verbal comments keypunched).
(13) Automatic generation of data summaries.

For the device to be truly portable, it must be relatively small, lightweight and have an internal power supply capable of operating it for a number of hours. The physical design this implies must at the same time be compatible with the ruggedness required of the PDR. Ease of use involves both physical configuation and required operational procedures. Since the PDR is to be controlled by a microprocessor, its operational procedure will, for the most part, be a function of its software design. Therefore, the physical as well as software configuration of the PDR must be designed with a very conscious understanding of the problems and attitudes of the final user in mind.

SUMMARY

There are two general categories in which the existing data-handling system could be improved. These include the elimination or simplification of any steps in the current system and an elimination or decrease of error sources present in the system. A properly implemented Portable Data Recorder will provide significant improvements in both of these areas.

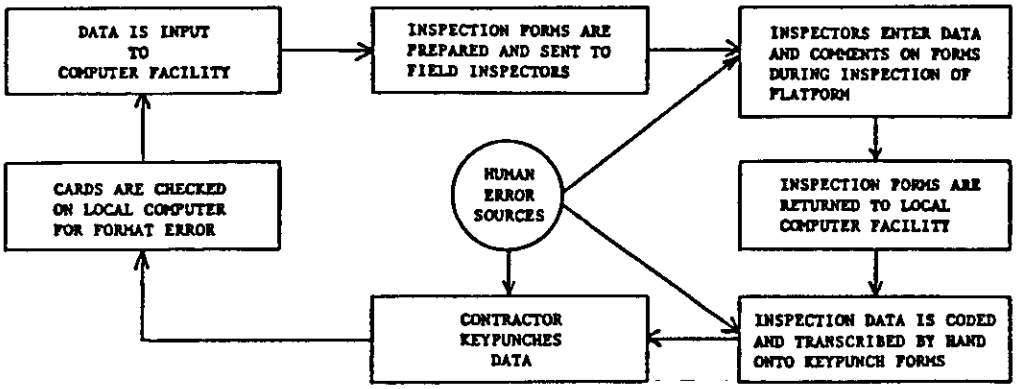

FIGURE 1. DATA-HANDLING SYSTEM CURRENTLY IN USE BY USGS

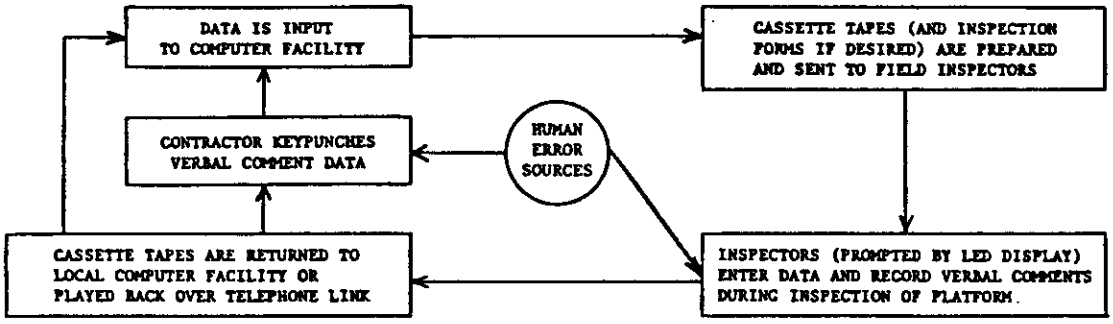

FIGURE 2. PROPOSED DATA-HANDLING SYSTEM USING PORTABLE DATA RECORDER